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The Sinews of Research

One of the most interesting problems upon which to speculate is the financial return yielded by research activities to those Governments, industrial undertakings and private individuals who have sunk money into them. Unlike an employers' federation, it can seldom be stated that as a result of an effort there is an annual gain of so many pounds to the industry. For instance, when the I.N.C. persuaded the Ministry of Supply to increase prices of iron castings by 8 per cent., it meant a gross increase of selling prices of something of the order of half a million pounds to the industry—a fact sometimes lost sight of. We are unaware which is the most expensive form of research, but it is probably of the "hit and miss" variety. One example was quoted by Mr. H. J. Maybrey at the last meeting of the London Branch of the Institute of British Foundrymen. Here was a complicated casting which the customer insisted must be die cast. Many hundreds of pounds were expended in making a suitable die. After the production of six castings, the design was changed, and the die scrapped. No doubt our readers could give many other examples of equally futile and expensive research.

It seems natural to pass from the most expensive to the cheaper forms of research, and the following true story provides the link. During the last war we encountered in a factory of one of our largest armament firms a curious individual making vain attempts to make steel in a freak electric furnace. He enlisted our advice, and conversation revealed that he was totally ignorant of even the names of commercially successful plants. His qualification for being allowed to spend so much money was some cock-and-bull story of having constructed and operated such a furnace in a Continental armament works of international repute.

Thus we arrive at the cheapest and safest aspect of research work, and that is as full a knowledge as possible of what has been accomplished in any field. Some years ago, a Government department was led to consider the advisability of initiating practical research into the efficacy and provision of safety gear on mine cages, with a view to making recommendations for the amendment of existing legislation. There appeared to be some justification for the use of these safety catches, since their provision had been compulsory for many years in certain Continental countries and in several of the United States of America. As a first step, a complete survey of the literature, both periodical and patent, was prepared, and this revealed that over decades inventors in those countries favouring the use of these catches had produced several thousand designs, which had made varying progress towards practical realisation and adoption. Hosts of these devices were stillborn and got no further than model tests, while a selected few, but still numerous, designs, reached the stage of actual installation at pit shafts. Of these, accident statistics showed that as many devices come into untimely operation, frequently with fatal results for the occupants of the cage, as operated on the rope breaking or on overspeeding, *i.e.*, when called upon to perform their due functions. The report, based solely on the information stored in the published literature over a period of roughly a century, presented a *prima facie* case against the probability of any useful results being arrived at by further research on a subject which had already been investigated *ad nauseum* in other countries, and at the same time confirmed the opinion held by British mining engineers that the best precaution against winding accidents lies not in the provision of additional and complex safety gear, but in the use of a strong winding rope kept in a safe condition by periodical supervision and maintenance.

Modern research is based on the availability of information of past work; the collecting and marshalling of this information forms the surest and indeed the indispensable foundation of planning fruitful, future investigations. There are few problems of which some relevant aspect has not already been dealt with in some of the thousands of journals making up the specialised periodical literature of the world. The value of such bibliographical research is frequently unappreciated, for many an inventor has been bitterly disappointed when told by the Patent Office officials that he has been anticipated by some individual he has never heard of. Yet he should really be grateful, for normally, with the granting of a patent, severe headaches, consequential upon its exploitation, ensue. Being so thoroughly convinced of the value of technological publications, we were somewhat shocked to receive from the Controller of Salvage a letter for publication advising the conversion into scrap of accumulations of trade papers. As this term usually embraces technical journals also, we protest very strongly, especially as under present conditions we have constantly to advise foundry technicians to borrow old copies of the JOURNAL containing valuable Papers from neighbouring concerns and public libraries.

Movements in Scrap

BY "ONLOOKER"

On a numerical basis of comparison scrap may not be the equal of the virgin metals ton for ton, but if process scrap be included in the survey it will be found that secondary metal to-day bulks very high in the make-up of the heats in the foundries in this country. The part played in the manufacturing cycle by process scrap is well worthy of consideration and probably does not receive the attention it deserves at the hands of the statisticians. The ideal arrangement is for waste arising during the processing of metal to return to the casting shop in order that it may be utilised again for production of similar material, but there are, of course, certain obvious difficulties. It may happen, for example, that the scrap made during the manufacturing process arrives at a point far removed from the foundry where the casting was performed, and in consequence of this, distance operates as an economic deterrent to the return of the metal to its point of origin. Again, waste may come off the machines in a form which makes its absorption by the foundry out of question, the only outlet being in connection with a different and possibly less valuable type of product. Reasons such as these may be the cause of scrap passing into merchants' hands.

In addition to the scrap arising in this manner there is also the material which makes its appearance as the result of dismantling obsolete or worn out installations, renewals of plant, etc., and in general this type passes into consumption through the medium of the middleman. The trade in old metals in this country is important and old established, the capital involved being considerable and the ramifications widespread, nor has the period of the war, with control in so many directions, interfered unduly with its activities. The great difference at the present time between the situation obtaining in virgin metals and that ruling in scrap is that whereas in the former case selling is vested in the Controller of Non-ferrous Metals, acting for the Ministry of Supply, and buying, too, for that matter, the handling of secondary metals remains in the hands of the scrap-metal merchants, whose activities are limited only by the observance of those rules relating to licensing, and, of course, the range of official maximum prices. Critics of the handling of the scrap situation here since 1939 have pointed to the fixing of maximum prices as a cause of misunderstanding and trouble, but in the early months this proviso acted as a necessary brake at a time when metal supplies generally fell short of demand.

Misconception may have arisen, not from faulty framing of the Order but through the fact that circumstances led to a long spell of trading on the basis of the upper limit permitted, as a result of which many people fell into the error of conceiving that the official maximum quotation was in fact the established price set up by the Ministry. The first holders of scrap certainly expected to secure the maximum figure and in this way they were almost uniformly successful, as a result of which the ultimate consumer, with carriage, handling charges, etc., to pay, found that in the long run the cost to him was in many instances but little short of the virgin metal price. Small wonder that, faced with this charge, some manufacturers cold-shouldered old metals and embarked on the process of changing over to an increased usage of virgin material. Even so, the trade generally is absorbing very large quantities of scrap, but, obviously, there are limits to this and moreover not every type of old metal is suitable for the production of the class of material called for to-day. Grading and sorting is highly important and close attention should be paid to this aspect of the scrap problem.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

To the Editor of the FOUNDRY TRADE JOURNAL.

Valves for Mixing Blacking

SIR,—I am indebted to Mr. Capwell for his letter in this column of August 21 issue and also for the very interesting leaflet explaining the valve which he mentions, namely the Saunders valve. I have included here a sketch taken from the leaflet showing the operation of the valve. The action depends on the gradual depression of a dished diaphragm of rubber or other flexible material until it is in firm contact with the valve's seat in the completely closed position. This valve would, I believe, solve the question of leakage developed due to wear in the ordinary plug valve handling black wash or other gritty liquids in the multiple tank type of mixer as referred in the Paper.

The wear and consequent leakage of valves in the pipe circuit is however only one aspect of the trouble, as the pipes themselves wear, as do the pump impeller and casing. The compressed-air mixing type now used in our foundry has no valves, and the elimination of the pumping and rapid circulation cuts out the wear on the tubes, etc. The case of the valves for drawing off the black wash is slightly different because of the fact that during extended stoppage the solid materials settle in the valve

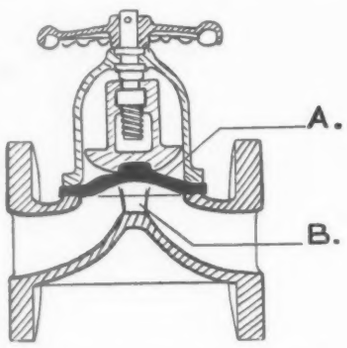

FIG. 1.—SKETCH ILLUSTRATING THE OPERATION OF THE SAUNDERS VALVE. A—DIAPHRAGM. B—VALVE SEAT.

body and may have to be freed. The type recommended in Fig. 5 of the Paper would close satisfactorily; allow very thick solutions to run, and could be readily freed by the usual method. Pushing a wire into the valve illustrated would probably damage the diaphragm.

In conclusion, I may say that this type of valve is actually in use on the two air mixers now in our foundry. Although beyond a hazy notion that the valve had rubber facings, I had no idea how it worked, having had no reason to open it for repairs or attention, and the first valve used was merely sent into the foundry for trial under difficult conditions. These valves were incorporated in the air line because it was noted that the trial valve gave a very sensitive control of the air delivered, especially when very low volumes of air were required. I do not wish to convey the impression that the process of mixing in the pump type described in the Paper was defective most of the time, indeed the machine would probably produce and remix many times over, say, 20,000 galls. of black wash before leakage became noticeably troublesome.—Yours, etc.,

WM. Y. BUCHANAN.

Dunconnell, Johnstone.
August 25, 1941.

Random Shots

The beginning of the third year of war provides an occasion for looking back at one's thoughts during the first few days of this world-wide calamity. It was in just such weather as is prevalent to-day that industry broke into its fever of production; that young men put off their cool cricket shirts and flannels to don the stuffier service uniform; and even the less important civilian felt the need for immediate action, which he satisfied by digging trenches and filling sandbags.

* * *

On that occasion "Marksman," also feeling the urge for action, took his pen and wrote with extra fervour and vigour some seemingly trite truisms which the events of the past two years have proved to be not quite so trite after all. Such sentiments as: "It is perseverance that is going to win the present struggle" and "cast-iron constitutions will be tested to their utmost of strength," mean as much to-day as they seemed genuine then.

* * *

"Coin is the sinews of war" was a quotation which "Marksman" ventured to suggest at that time might provide a note of hope for this country, and here, at the beginning of the third year, the Chancellor of the Exchequer speaks very favourably of the state of the nation's finances, thus striking the same chord of hopefulness and strength.

* * *

The Editor, too, has his reminiscences; those of evacuation, of which many a firm will have tales to unfold after the war, of difficulties overcome and of humorous situations caused by the suddenness of the emergency. When the journal finally "went to bed" there wasn't a single comma or full stop left on the premises with which to fill up any awkward blanks. Reserve "copy" had not yet arrived on the van, and the printers were not in a position to "hand set" any bright paragraph he might have been obliged to conjure up. After two years of functioning merrily in the country, once the upheaval had been smoothed over, many a London firm will be wondering how they can ever again work cooped up in a dark City office!

* * *

"Marksman" has it on unimpeachable authority of a well-known core-shop foreman that the beer with the best chemical analysis in the country has the worst taste. Therefore, in the interests of truth, connoisseurs of that much-sought-after beverage should voice their appreciation by saying "That went down well" in preference to the usual "that's good beer"!

* * *

Mrs. Malaprop announces that her son has just been moved from the depravity to the precious die casting shop.

* * *

The best crossword clue of the week comes from "The Times":—

Clue: Fellow multiplied by puss.
Answer: Manx cat.

"MARKSMAN."

U.S. Scrap Consumption

United States consumption of iron and steel scrap in the first five months of 1941 is estimated by the Institute of Scrap Iron and Steel at 22,127,000 gross tons, compared with 14,730,000 tons in the corresponding period of 1940. Beginning with last October, domestic consumption has exceeded 4,000,000 gross tons for six months, and has barely been under 4,000,000 tons in two months. The result has been to drain away available supplies without giving the industry an opportunity to accumulate material. Scrap exports have been drastically cut, and in the January to May period totalled only 357,000 gross tons, against 1,161,000 tonsa in the parallel period of 1940.

Casting in Rubber Moulds*

A NEW METHOD OF CASTING LOW MELTING POINT ALLOYS

By FRANK K. SMITH

Casting alloys at temperatures up to 315 deg. C. in rubber moulds was thought by most rubber experts to be impossible. However, rubber has successfully replaced sand and other mould materials, and to-day is used by scores of plants in the United States and Canada. This new method of casting, while still in its infancy, promises to become important in many lines of manufacture. In the short span of 18 months, it has completely revolutionised the jewellery industry.

The origin of rubber moulds for the casting of low-temperature alloys is obscure. Several individuals claim to be the originators, but documentary proof is lacking. It is believed the idea came from dentistry, where rubber was and still is used to produce moulds for the casting of wax models; in turn, these are used in casting dentures and bridgework in precious metals.

Many Problems Solved

It is certain that the incentive for the great recent development in rubber moulds was provided by the jewellery industry, where it is especially applicable for many reasons. In this industry a device or process which will produce the unusual or make possible the fabrication of any item at less cost is quickly accepted, as the success or failure of a jewellery manufacturer depends on his ability to create new motifs or adopt expensive items to low-cost volume production.

Rubber moulds offer the opportunity to produce undercut designs, an accomplishment formerly considered impossible. This fact alone has created wide-spread interest. There were, however, other reasons. Rubber moulds can, in many instances, eliminate hand-cut bronze moulds, which are expensive, costing in some instances £25 for a single mould and requiring one or two weeks' time to make. On the other hand, a rubber mould can be made in a few hours at a cost of less than £1.

Sandcasting had always been considered essential for sample work and for expensive items which would not run into volume production. Here, too, rubber moulds offer a better way by producing a finer casting which requires far less finishing and only a low-cost semi-permanent mould. Another factor is the demand for large seasonal lines. In recent years this demand has increased until it presents a very serious problem, as it is necessary for the manufacturer to build expensive moulds during the course of a year for, perhaps, a 100 or more items and then find that only a very small portion of these are accepted by the buying public. This, of course, means a heavy loss on the unused moulds. Rubber moulds provide the solution to this problem, for with rubber a manufacturer can produce an even greater line at less cost, and the amount of loss on rejected items is negligible because of the low unit cost.

First Efforts Successful

While the first rubber moulds were crude, they revealed the possibilities of this type of casting, so development was rapid. In early stages, a mould was made by using two steel plates 8 in. long by 6 in. wide by ⅛ in. thick having three bolt holes on each side, and a frame 6 in. long by 4 in. wide and 1 in. high and ¼ in. thick. The procedure consisted of laying the frame on one of the plates, filling it half full of moulding plaster diluted with water to the proper consistency, and mounting the desired model in this plaster in a manner that left the model half imbedded in the plaster. The plaster was then permitted to dry thoroughly. Generally heat was applied to hasten the drying.

When dry, a rectangular piece of rubber 6 by 4 in. and slightly more than ¼ in. thick was forced into the frame on top of the mounted model, having previously been preheated until soft. The top plate was then set up and the six bolts tightened by hand. The entire set-up then was placed in an oven over an ordinary single-burner gas plate.

The frame temperature was then raised to 65 deg. C., measuring the temperature by a thermometer inserted through a hole in the side of the oven and resting on the steel plate. Readings were somewhere within 20 deg. of the actual temperature. Upon reaching 65 deg. C., the frame was removed and all bolts were tightened with a socket wrench, the frame returned to the oven and heated for two hours at 140 deg. C. The mould was then considered cured, so after cooling for 45 mins. the bolts were loosened, the plaster and rubber removed from the frame, and the plaster dissolved in water, leaving the model imbedded in the cured rubber.

This piece of rubber with the model in it was now placed back in the frame with the model side on the top. An unvulcanised piece of rubber, 6 by 4 by $\frac{17}{32}$ in., preheated until soft, was placed in the frame, the top plate adjusted, the bolts hand-tightened, and the same procedure repeated. Upon cooling the completed mould was forced out of the enclosing frame and split by inserting a dull instrument between the two parts. The model was removed during this operation, and the mould was then ready for gating.

Gating and Centrifugal Casting

Gates were cut from the 4-in. end of the bottom or back side of the mould to the impression, and were graduated from a large opening at the end to a small entry gate at the impression. The appearance of the gates on one of these moulds could be compared with a tree—the trunk being the supply channel and the limbs the feed gates.

After gating, the mould was ready for casting, which was done in a centrifugal dental casting machine of the spring type which consisted of a horizontal arm mounted on a shaft rotated by a spring. A release pin held the arm under tension until released. The arm was stepped down 0.5 in., 6 in. from the end, and was 4 in. wide. Directly before the stepdown was a cup-like depression with a channel cut through the step.

In casting, the joined mould was placed on the flat end of the arm, with the channel opening of the mould forced against the channel cut through the step. A flat steel plate, 6 by 4 in., was clamped on top of the mould. The machine was wound up by hand and the release pin raised to hold the arm. A ladle of molten alloy, consisting of tin and antimony, was poured into the cup-like depression, the pin released, and the arm permitted to spin. This set up enough centrifugal force to cause the metal to flow from the depression into the mould to form a casting.

The life of these early moulds was short, and it was not unusual for a mould to burn out after 10 or 12 pours. It was an exceptional case when a mould could be poured 40 to 50 times. It took practically a full day to make a mould which, in most instances, lasted only an hour or two in actual production.

Rapid Developments

After trying rectangular moulds with several cavities a circular mould and a revolving table

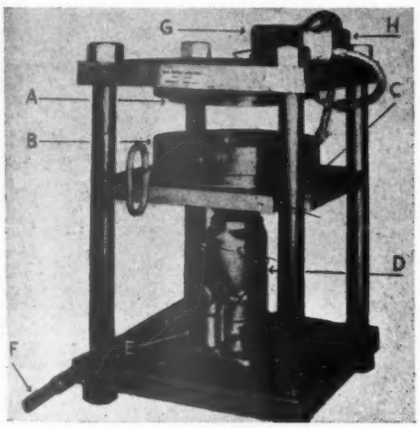

FIG. 1.—ELECTRICALLY-HEATED AND AUTOMATICALLY-CONTROLLED VULCANISER FOR MAKING RUBBER MOULDS. A and C—plunger plates; B—removable ring; D—hydraulic jack and plunger; G—thermostat controlling heating elements; H—switch.

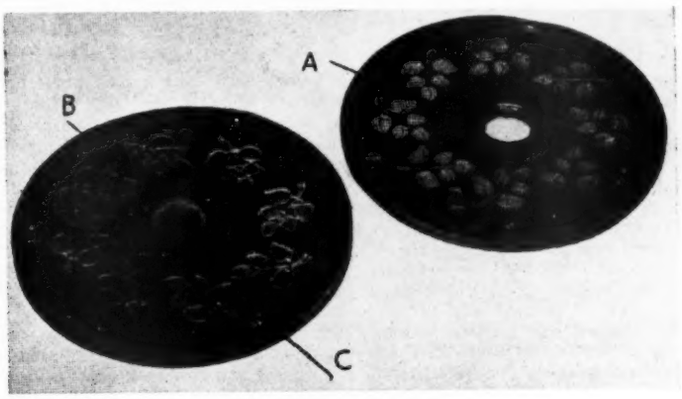

FIG. 2.—TYPICAL SET OF PATTERNS MADE OF RUBBER, BEFORE GATING. A—pouring hole; B—bronze centre sprue to support molten metal; C—guide bolt.

* Extract from an article which appeared in "Steel." The author is of the Mark Weisberg Laboratories, Providence, R.I.

Casting in Rubber Moulds

were adopted. The metal was poured into the centre of the mould while the mould was revolving at a high speed. Making and vulcanising the mould was improved by placing the models directly between the two discs of rubber and vulcanising the entire mould in one operation.

While it still took 6 or 7 hrs. to make a mould, multiple castings were produced and the process became so practical it was quickly adopted. As the demand for equipment increased, the mechanical features were developed and improved until the process of to-day resembles the equipment of just 18 months ago only in theory.

Type of Rubber Used

The first consideration is the type of rubber. While many compounds are available, few are suited for this work. No one compound is adaptable for all types of casting, but it is possible to define two compounds which take care of most ordinary requirements.

The first of these compounds is for castings having modulations, undercuts or other irregularities. This material has a specific gravity of 115 to 120, plasticity of 20 to 24, durometer hardness of 60 to 65, and a tensile strength rating of 2,600 lbs. per sq. in. It is the most widely used compound. The second compound is for flat work. It has a specific gravity of 128 to 132, plasticity of 30 to 38, durometer hardness of 70 to 75 and a tensile strength rating of 2,600 lbs. This material is employed primarily for plane surfaces, although it may be used for other types of work.

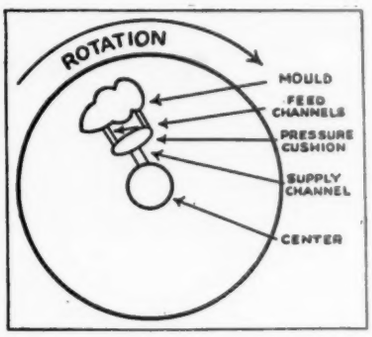

FIG. 3.—SYSTEM OF GATING EMPLOYED.

The present method of casting in rubber utilises two 9-in. by $\frac{17}{32}$-in. rubber discs, with one disc having a $1\frac{1}{8}$-in. centre hole. When the proper quality of rubber has been determined, the next step is to lay out the models on the disc which has the centre hole, allowing for proper gating.

Then markings are made for guides which are placed between the models. Each mould should contain at least three guides to prevent the mould from shifting. A hexagon head bolt cut off $\frac{1}{4}$ in. from the head is the most common guide. After marking for the guides, the models are removed and holes, slightly smaller in diameter than the bolt shanks, are punched through the disc. Guide bolts are placed in these holes.

The next step is to determine whether or not the models require backing—necessary if the models are highly domed or deeply modulated and also used in some instances to adjust the height so the parting line may come in a specified position. In backing, a piece of rubber the size of the model, or slightly smaller, is cut from a sheet of $\frac{1}{8}$-in. or $\frac{1}{4}$-in. rubber. The surface of the mould is cleaned by scraping and washing with benzine or naphtha, and the backing is cemented to the mould.

Next the surfaces of both discs are covered with a separating agent such as graphite, talc, zinc stearate, soapstone or glycerine. After all excess is removed either by blowing or wiping, the two discs are laid on top of the vulcaniser for preheating. This vulcaniser is electrically heated and automatically controlled by a thermostat G (Fig. 1). H is the control switch. A pilot light indicates when the vulcaniser has reached temperature. When preheated until warm and soft, the disc with the hole is placed on a board $\frac{1}{8}$ in. thick by 6 in. square, and a bronze centre, or sprue, tapered $1\frac{1}{4}$ in. to 1 in., is placed in the hole with the tapered side down.

Now the models are laid out on the discs as predetermined. With the vulcaniser heated to the operating temperature of 150 deg. C. the upper ring B is removed from the vulcaniser and slid over the disc mounted on the $\frac{1}{8}$-in. board. Then the other disc is placed inside the ring and pressed tightly against the bottom disc. The entire set up is then lifted carefully and placed in the vulcaniser on the $\frac{1}{4}$-in. plunger D. Care is taken not to tip the set up ring as the models might slip out of position.

The vulcaniser is a floating ring type with the two plunger plates A and C serving as terminal points of pressure on which a $1\frac{1}{4}$-in. ring may adjust itself regardless of variations in the size of the mould vulcanised. The two electrically-heated plungers can develop a temperature of 185 deg. C. With the ring on the bottom plunger, the hydraulic lift E is operated by pumping the handle F until the top plunger enters the ring. The mould remains in this position for two minutes. Then it is forced up full, using one hand only.

Low Wastage

Excessive pressure does not tend to make a good mould. It generally takes some practice to determine the exact pressure. However, the range is not critical and it is practically impossible to spoil a mould if minimum care is taken.

After vulcanising for 45 min. the hydraulic pressure is released permitting the bottom platen to drop until the ring can be lifted from the vulcaniser. The mould is forced out of the ring and allowed to cool for 5 to 10 min. before gradually opening the mould with a blunt instrument by working it around the edge of the mould. After splitting, the mould may be immersed in cold water to hasten the cooling.

Fig. 2 shows the mould after splitting and before gating. A is the entry point vulcanised into the mould by the bronze centre sprue. B is the slight depression made by the bronze centre sprue, which serves as a base for the poured metal. C is the guide bolt after it has been vulcanised into the mould.

The mould is now ready for gating which is done with a razor blade or scapel. Fig. 3 illustrates the best system of gating. A large channel is cut from the centre to a large oval cut-out which acts as a pressure cushion. From here small gates are cut as feed channels to the depression. The pressure cushion produces a more uniform flow of metal than if the gate were cut directly from the point of entry to the depression.

The melting pot may be any conventional type for low melting point alloys and should have an adequate gas supply. Automatic heat control is essential as the temperature of the metal is of the utmost importance. The control should have a range between 50 and 535 deg. F., calibrated with graduations of 13 deg.

The temperature of the metal depends on the type of alloy used and the type of item being cast. In general, items with fine lines use higher temperatures, heavy or plain items use low temperatures. The average operating range is between 260 and 315 deg. C. The most common alloy employed consists of 98 per cent. tin, 1 per cent. copper and 1 per cent. antimony. Alloys containing lead and zinc and other elements may be used.

Fig. 4 is the inner part of a modern centrifugal casting machine. Here B is the point of entry where the hole in the plate connects with the hole in the finished mould. The mould is spun at a peripheral speed approximating 6,000 ft. per sec. The swing arms lift from centrifugal force to exert pressure on the top plate, locking the mould in position. The pin G stops the top plate from turning and prevents the mould from moving. C is a 4-in. thrust bearing on which the plate rotates. D and E are 2-in. surface ball bearings operating around a $\frac{1}{2}$-in. shaft. F is a nickel chromium steel suspension bracket which serves as a base for rotation.

Before casting, the mould surfaces are dusted with powdered talc or soapstone. With the moulds in position, the cover is closed, the motor started and the molten metal poured into the wooden crucible at top. The machine is permitted to spin for approximately 30 secs., which is about the time required to place the ladle back into the melting pot and cut off the switch. When the machine stops, the mould is removed, the castings taken from the mould and the procedure repeated.

In many instances the first gating does not produce the proper cast but the first casting shows what needs to be done. If castings are not full or are porous, it generally may be assumed that air is pocketing in a depression. This may be eliminated by drilling through the rubber with a No. 40 or 45 drill and cutting a fine outlet from the affected point to the hole. This permits the air to be released from this portion of the depression and should correct the fault. For sharp pointed depressions often it is necessary to drill directly through the mould at the tip of the point.

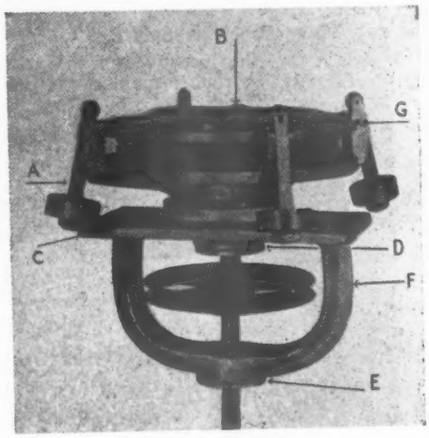

FIG. 4.—INNER PART OF A MODERN CENTRIFUGAL CASTING MACHINE. A—one of four swing arms exerting pressure on top plate; B—hole through which molten metal is poured in casting; C—4-in. thrust bearing on which assembly rotates; D and E—2-in. ball bearing mounting shaft; F—alloy steel supporting bracket.

It is evident that the procedure for making a mould and for casting have been simplified to a point where practically anyone can utilise rubber moulds for the casting of low temperature alloys. The cost of a 9-in. mould varies between 6s. to 12s. for a set of two discs, depending on the quality of the material. The proper rubber compound should be obtained from recognised source only. The life of a mould depends on the casting temperature and the type of item cast. The average life of a mould, casting fairly well-drafted work at a temperature of 300 deg. C., is from 500 to 600 pours.

Production Capacity

The total production obtained from these moulds depends, of course, on the number of

(*Concluded on page* 174.)

Melting Furnaces for Grey Cast Iron

A REVIEW

By H. H. SHEPHERD

It is to be regretted that Mr. L. W. Bolton cannot be present to present this Report, because, despite the fact that it is in general the result of much time and work on the part of the Melting Furnaces Committee, it can safely be said that the success of this excellent work is very largely due to Mr. Bolton's unstinted work and keenness in correlating all the information received from the members and other sources, in addition to drawing upon his own wealth of information on cupola practice.

The Committee comprised, in addition to Mr. Bolton, the late Mr. S. E. Dawson and Mr. V. C. Faulkner, Mr. J. Jackson, Mr. C. H. Kain, Mr. F. K. Neath, Mr. A. G. Robiette, and Mr. E. W. Wynn, whilst the reviewer also is a member.

The reviewer would like to take this opportunity of paying tribute to the late Mr. Dawson, for he, too, put in a great deal of work in connection with those sections which deal with the cupola and rotary furnaces.

The Report, which was published in January, 1940, is available only to members of the Institute, and it is certain that all who have studied it will agree that it is the most valuable and concise text book yet published on the subject of melting furnaces, especially as applied to the melting of cast iron; and that it truly provides an excellent source of reference for those who wish to study the various methods of metal melting.

The various melting media are dealt with in five chapters, having the appropriate headings:—(1) Crucible furnaces; (2) air furnaces; (3) electric furnaces; (4) rotary furnaces; and (5) cupola furnaces.

In addition there is an introductory chapter which contains a very useful table of classification of furnaces employed for the melting of metals, and the Report concludes with a chapter on melting costs in which some very interesting and comparative figures are given.

This section could no doubt involve a whole afternoon's debate, for, as is well known, the subject of melting costs bristles with facts and fancies guided or decided upon by a particular works practice or accountancy, and therefore one may disagree with the methods used in arriving at the melting cost figures given in the Report, or with the allocation of costs, but it will be agreed that in this chapter there is available some most valuable information, be it to answer an inquiry as to cupola costs compared with pulverised-fuel-fired rotary furnace costs, or what are the relative melting losses for the various types of melting media.

Before further considering the Report, it is desired to make it clear that it is not intended to serve as a detailed text book on the melting of cast iron—although there is in the section dealing with cupolas a detailed recommended practice for operating a 36-in. cupola, which will be referred to later—but merely to set out in as clear and concise a manner as possible a simple description of each type of melting furnace dealt with, and the essentials as to lining, repair and operation, together with typical examples and figures of operation as applied to cast iron.

Crucible Furnaces

As is pointed out in the Report, this type of furnace is not now used to any great extent for the melting of iron, though there are no doubt a number of small foundries in the Midlands and elsewhere which might employ crucible melting for very small outputs, though even in these cases the cupolette has largely replaced crucibles. Where crucible furnaces are available, however, they do form a very convenient means of producing small quantities of metal of special analysis.

From a capital cost point of view, crucible melting is the cheapest; on the other hand, though, production working costs are relatively high. The operation of these furnaces is very simple, and since the metal is melted out of contact with the fuel, contamination by impurities, such as sulphur, is comparatively negligible, if any, whilst changes in composition during melting are very small as the result of very low total melting losses of the order of ½ to 1 per cent. These furnaces can be fired by coke, oil, gas or electricity, though, when the latter is used, the furnace is more correctly designated as an electric induction furnace.

The stationary or pit furnace is the oldest type of crucible melting furnace, but it has largely been replaced by the tilting furnace which renders metal handling and distribution so much easier. Air blast in the latter type is supplied by blowing fans, whilst for the former, natural or stack draft is relied upon. The Report states that using coke firing a 350-lb. charge of iron will require 2 to 2½ hrs. or about 20 per cent. longer if superheating be required, before the iron is ready for pouring. The coke consumption is given as ranging between 34 and 43 per cent., the higher figure being for a "cold start." Oil melting is much cleaner than coke, but in these days it is not altogether favourable, whilst gas can only successfully compete with coke when large quantities are available at low rate.

Air Furnaces

These are not used to any great extent for the melting of ordinary cast iron, and therefore it is not necessary to spend much time in considering them. They are mainly used in the melting of iron for malleable castings, and for certain special classes of work such as the manufacture of chilled and grain rolls. The Report briefly describes the air furnace and outlines the methods of operation.

Originally all air furnaces were hand-fired using lump coal, but the more modern methods employ pulverised coal or oil firing. Using solid fuel a ratio of 2 of metal to 1 of fuel is considered satisfactory, whilst for pulverised fuel consumptions of between 0.25 and 0.4 tons of coal per ton of metal have been quoted by various authorities.

A melting rate of 30 mins. per ton represents good practice. Melting losses per element are fairly high at about 10 per cent. for carbon and 25 per cent. each for silicon and manganese, though much higher losses are often experienced with the low silicon irons.

The advantages of the air furnace are that sulphur pick up is negligible as the fuel is not in contact with the metal, and that it is possible to hold a charge in the furnace whilst a sample is taken for examination, thus permitting composition adjustments to be made. It is one of the most expensive and certainly the least efficient melting unit when judged from a thermal efficiency standard, as the following figures show:—

Air furnace thermal efficiency ..	9 to 15
Cupola furnace thermal efficiency ..	36
Electric furnace thermal efficiency ..	55

Electric Furnaces

A very useful and informative chapter deals with this modern means of metal melting, and induction, resistance and arc furnaces are considered. If efficiency of melting practice be considered without regard to cost it will be realised that practically and theoretically the electric furnace is the ideal unit.

Apart from the crucible it is the most expensive method of melting, and only becomes a competitor to other methods when it is possible to use cheap scrap such as borings, turnings, clippings, etc., to affect the additional melting costs.

So far as melting of cast iron is concerned, the electric furnace is most usefully and economically employed when it forms part of a duplex process serving as an adjunct to the cupola to secure uniform mixing, addition of alloying elements, and superheating to any desired degree and to control casting temperature.

The low-frequency induction furnace is not particularly suitable for superheating cast irons, but the coreless induction furnace is particularly applicable for carrying out these operations, and it is made in capacities up to 8 tons. Heat is generated in the charge by eddy currents induced in the metal by current flowing through a water-cooled coil surrounding the crucible. In general the high melting costs prohibit its use for direct melting of cast iron.

With regard to arc furnaces, the Report states that 95 per cent. of electrically melted or superheated cast iron is produced by this type of electric furnace, and that the reasons for this are: (1) Lower first cost; (2) simplicity of operation; (3) facility with which superheating can be obtained; (4) low maintenance costs, and (5) possibility of using a large bath for continuous melting and superheating.

Direct arc furnaces are used by a number of firms in U.S.A. either as direct melting units or as part of duplex melting systems for the production of malleable iron castings. The procedure for melting and superheating in direct and indirect arc furnaces are described with some detail as to output, power consumption, etc., in the Report. The application of the indirect rocking arc furnace to cast-iron melting and superheating is comparatively recent. Briefly the furnace consists of a cylindrical refractory-lined shell with two or three electrodes situated approximately on the horizontal axis. These strike an arc—independent of the charge—in the centre of the furnace. The furnace is rocked continuously through the required angle, the maximum of which is 180 deg., and this rocking distributes the heat of the arc. One door serves for charging and pouring.

Basic and neutral linings have been used, but for highly alloyed cast irons magnesite bricks are preferred. The average capacities for this type of furnace range from ½ to 1 ton, but the direct arc furnaces are made suitable for much heavier capacities ranging from 2 to 15 tons or more.

In the States the indirect rocking arc furnace is used by a few plants for the melting of grey and malleable cast iron. Total melting losses are given as 2 per cent. for the direct arc and 1 per cent. for the indirect arc furnace.

To sum up this consideration of electric furnaces it seems desirable to quote from the Report (page 33, last paragraph) the following:—

"*Metallurgical and Operating Features of Arc Furnaces.*—The atmosphere in an electric arc furnace properly operated and maintained need not be oxidising to any extent. Providing the doors and electrode entries are kept tightly fitting, the atmosphere will be definitely reducing, due to the presence of the incandescent carbon electrodes. This allows light scrap such as borings, turnings, sheet clippings, etc., to be melted with a low loss both of the original metal and of individual constituents such as carbon

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* Confidential Report issued by the Institute of British Foundrymen, through the Melting Furnaces sub-committee. This Review was presented to the East Anglian section for discussion, Mr. Geo. Hall presiding.

Melting Furnaces Report

or silicon. Moreover, readily oxidised alloy elements such as chromium can be conserved on remelting scrap. Further, the small loss which does take place is more or less constant under standardised melting conditions. This enables the composition of complex alloy irons to be computed accurately from the ingredients of the charge."

Rotary Melting Furnaces

The names of Bracklesberg, Sesci and Stein are now very well known to foundrymen in connection with rotary furnaces. However, it must not be thought that the idea of rotating a melting hearth so that the metal is always in contact with the hot lining is new, for it dates back many years. Bessemer, for example, realised the many advantages which might arise from this type of melting plant.

As the Report so aptly puts it, this method "allows the melting of metal relatively rapidly and cheaply out of direct contact with the fuel which is an important consideration in the production of low-carbon cast irons. It possesses the advantages of the batch type of furnace, as distinct from a continuous furnace such as the cupola, that the metal may be superheated to a very high temperature if desired and may be held at temperature while samples are taken for examination. Any necessary adjustment may then be made to the composition before the metal is tapped. Another advantage of the rotary furnace is that light scrap such as cast-iron swarf or steel clippings may be melted, thus enabling a cheap mixture to be employed."

Rotary furnaces are similar in general principles of design and operation. They comprise cylindrical shells fitted with conical ends and lined throughout with refractory. The furnaces may range from ½ to 10 tons in capacity and they are being used very successfully in the direct melting of iron for malleable (black and whiteheart) and grey iron castings.

Melting rates are about the same as those of air furnaces, a 5-ton charge requiring about 2½ hours when melting from "cold start," whilst the quality of the product is equal and the cost per ton very much less. The fuel consumption ranges from 16 to 19 per cent. per ton of molten iron.

The rotary furnace is an intermittent tapping unit, but it can bring about a continuous metal supply if employed as a battery comprising several furnaces. As with the air furnace, when exact analyses are required the metal can be held in the furnace whilst a rapid analysis is made prior to making final adjustments.

The type of burner will depend upon the fuel used, the Brackelsberg being operated on pulverised bituminous coal, while the Sesci uses bituminous coal in the first period of melting and for the remainder of the melt pulverised anthracite coal; where the heat in the waste gases is not utilised only soft coals can be used. The Stein furnace originally used fuel oil only. These furnaces are usually lined with acid material and the life of a lining varies from 200 to 250 heats when melting malleable or grey iron. The total melting losses vary between 2 and 3 per cent., whilst silicon and manganese losses are in general lower than those resulting in cupola operation.

Cupola Furnaces

These furnaces are dealt with at some considerable length in the Report, and since their description, design and operation are so very well known, it is not proposed to make extensive references. Perhaps it is well worth while setting down at this stage the indisputable advantages of the cupola:—

(1) It is the quickest method of melting.

(2) Considering all things in general, it is the cheapest method of melting.

(3) It is the only melting unit which will give continuous supplies of metal over short or long periods.

(4) With the exception of the electric furnace, it possesses the highest thermal efficiency of any melting furnace, ranging from 35 to 45 per cent.

(5) If properly controlled, it will produce regularly a continuous supply of hot—and, what is more important, fluid—metal of high grade quality and possessing excellent mechanical properties.

The one important disadvantage is that, as the metal is in close contact with the coke, it tends to pick up impurities, especially sulphur, but correct mixture balance and fluxing will do much to minimise this "pick up." Fundamentally, the cupola has not altered in general design and method of operation over the 100 years or more of its history, though many attempts have been made to improve it; yet there is little doubt that among the few modifications which have succeeded in producing any major improvement in ordinary cupola operation, the introduction of the balanced blast system by the late J. E. Fletcher and the B.C.I.R.A. ranks highest.

Details of design and recommendation for dimensions are dealt with fully in the Report, and there is but need to stress the point that a steel cylinder stuck on end with holes for tuyeres, and the whole lined with a refractory, will not give economical or efficient melting practice. The overall height of the furnace, the distance from the lowest row of tuyeres to the charging door (which incidentally should not be less than five times the melting zone diameter), the design and position of tuyeres, the depth of the well, and the size of shell compared with the diameter of the lining bore, are all extremely important factors which must be given the most careful consideration.

As the Report points out, the internal diameter is the most important dimension, since this largely determines the melting rate which normally should range from 0.75 to 1 ton per sq. ft. per hr.; thus, a 36-in. bore furnace has a melting rate of 5 to 7 tons per hr.

The lining thickness should not be less than 6 in. in small furnaces, and in general should be 9 to 14 in. A too-thin lining leads to rapid heating of the shell and other troubles, while, if too thick, much extra coke will be required on the bed and first charges to take care of heat absorption by brickwork or lining. In general, the boshed form of lining gives most efficient results. As regards allowing for expanding output, it is inadvisable to exceed more than 2½ times immediate requirements.

Much could be said as to number, size, and height of tuyeres, but this is dealt with fairly fully. An interesting point is brought out with regard to well or hearth capacity of iron, this being given as 2 cwts. of molten metal per cub. ft. well volume.

In connection with air supply, figures of 140 to 160 cub. ft. of air per lb. of coke are mentioned as representative of average practice. As to the amount of air required per ton of iron, this will vary between 25,000 to 30,000 cub.-ft., and in general it is better that a minimum rather than maximum amount of air should be employed. The Report gives 12 to 14 in. water gauge as recommended pressures for small and medium cupolas and 18 to 22 in. for large cupolas.

The importance of weight of metal and coke charges and of flux additions is also stressed. Too large a metal charge may give non-uniform melting, and there is danger of bed dropping considerably with risk of sluggish and oxidised metal. On the other hand, light charges sandwiched between shallow coke charges may give rise to oxidised metal lacking fluidity. The Report recommends charge coke depth of about 6 in. and weight of metal charges in the ratio of one-eighth to one-twelfth of the hourly melting rate. It is the Reviewer's experience that the lower ratio usually gives the best results.

As to flux additions, these should be liberal, and amounts equal to 25 to 30 per cent. of the charge coke weight is given as satisfactory. Losses in melting are stated as: Iron loss about 5 per cent., silicon 10 per cent., and manganese as 15 per cent. Sulphur may increase by 25 to 50 per cent., whilst the carbon pick-up depends to a large extent on height of coke column and the original carbon content of the metal—a shallow well usually gives less pick-up, though it should be recorded that several authorities maintain that greatest carbon pick-up occurs in melting zone, and that there is no material increase in carbon content of metal in the well, but raising or lowering height of coke bed above tuyeres materially affects the pick-up.

Valuable information is given in regard to continuous tapping practice, and three procedures are referred to:—

(1) Suiting size of tap-hole to speed of melting. In this connection the Reviewer would mention that a ¼-in. hole will give about 5 tons per hr.; a ⅜-in. hole 10 tons, and a ½-in. 15 tons.

(2) Using a syphon brick.

(3) The running of metal and slag from same hole and separating them in the spout.

In conclusion reference must be made to information given in the Report on maintenance. This contains a valuable summary of replies to a questionnaire on cupola linings and patching materials, which is especially worth while studying by all interested or connected with cupola practice.

Finally short references are made to special cupolas, such as the Griffin hot-blast type, the balanced blast B.C.I.R.A. type, and the Poumay cupola.

DISCUSSION

MR. J. L. FRANCIS said that first of all he wished to record appreciation of the Sub-Committees' Report and of the concise and straightforward way in which it is compiled. His criticism was the lack of diagrams, no illustrations of the various furnaces being included. For the separation of charges of different grades of iron in the cupola by means of an extra coke charge, he did not recommend the practice, especially as the separation desired was usually for a higher quality or cylinder iron charge. The extra coke would doubtless form a check in the melting, but it would also tend towards a higher total carbon content of the special metal following it. In his view it was better to maintain uniform melting throughout and locate the special metal by running to a timed schedule which could be checked by keeping account of the number of charge units tapped. Another point raised by Mr. Francis was the single *versus* the double row of tuyeres. With the latter he thought that for a given diameter of melting zone a faster rate of melting would be maintained.

MR. W. L. HARDY said that it was incorrect to state that the cupola was the only means of maintaining a continuous supply of molten iron. It could be done by two electric furnaces working in conjunction, one melting and the other refining.

MR. GEO. HALL (Section President) raised the point about the advantage or otherwise of the receiver. He preferred a receiver himself and also supported the extra coke method of charge separation.

MR. L. E. SLATER asked which type of furnace was best in operation from the health hazard point of view.

MR. H. T. G. BROWN asked whether it was advisable to measure the volume of air passing to the cupola as well as the pressure.

(*Concluded on page* 176.)

Testing of Foundry Sand and its Co-ordination with Moulding Results*

PRACTICE AT GRIFFIN WHEEL COMPANY'S FOUNDRIES

By J. J. Boland, Chicago, Ill.

(Abridged)

Introduction

Sand control, from its very nature, took firm hold in the foundry industry once the industry became awakened to its possibilities; but, as is commonly the case when enthusiasm supplants more sober development, the past decade has seen such varied treatment of this subject, at A.F.A. and local foundrymen's meetings, that some confusion has arisen when attempts are made to determine the relation of this common material to moulding losses and casting appearance. Operating men in the Griffin Wheel Company organisation, like foundrymen everywhere, read and study the different Papers hoping to find a panacea for their puzzling problems, but they generally become lost in a maze of claims. The condensed summaries, that accompany the more lengthy Papers and articles, frequently are couched in such technical or scientific language and terms that the men using sand do not understand them.

As is natural, each writer covers his own problem to prove the points most important to him and, as a result, there have been many specialised discussions which have only narrow or limited application, rather than the development of principles which would be of broad significance. The experience of others helps, but the correction for trouble in one foundry may prove detrimental in another. All sand changes must be considered carefully before they are made gradually in the moulding shop. In the author's workshops the necessity of moving cautiously in changing sand mixtures or in substitution of bonding materials, to avoid going from one extreme to another, is stressed.

Problems Not Related to Sand

Apart from sand, there are many local conditions that are responsible for inferior castings. They can be blamed on sand, but actually be caused by iron melting temperatures, unbalanced chemical composition, rapid iron solidification, delayed pouring, flask equipment, pattern design, core binders, gating, venting, mechanical facilities, and a multitude of other causes involving the class of help available, sickness, and the weather. To illustrate:

Using the same kind of moulding machines as a successful foundry uses, but with the wrong kind of box equipment, will not produce good results; an inadequate supply of compressed air on moulding machines will ruin any foundry.

On one occasion, the writer recalls strange results in a heavy casting foundry where 80 lbs. of air was recommended for the jolters. This pressure was maintained at the machine until the valves were opened, then dropped rapidly due to the lack of a sufficient reserve supply. Indifferent results followed. When an additional air tank reservoir was installed in the line, the expected improvement did not follow until the air pipes leading to the operating valves were increased in diameter from ¾ in. to 2 in. Because so many cures had been tried before changing the size of pipes, every foreman in the shop had his favourite opinion, and it was hard to convince the men that improved air pressure was responsible for more uniform castings.

Moulding Shop Headaches

In another foundry, the defects "breakdowns" and "drops" were encountered on a large scale and attributed to sand. The organisation went through the process of introducing new moulding practices, changing the source of sand supply and adding rebonding agents, but the correction was not found until an observant clerk noticed that both of these defects were confined to moulds made on one of three cope jolting machines. This focused attention on that particular machine, and, although operations appeared normal, a good mechanic detected one bolt with half of the head cut off. This allowed the pattern-retaining plate on the machine to shift slightly on the roll-over operation.

When this single bolt was replaced and the plate held rigid as intended, good results followed without any other correction. Thus the foundry daily headache was averted. Now each jolter pattern has a special mark to identify the machine on which the mould is made. This simple means of prompt identification on the casting has been a big help, and the foremen wonder why it was never thought of before. Moulding machines on loose or weak foundations cause many troubles sometimes attributed to sand. The author will not discuss the results caused by off-iron conditions, because they are separate subjects, usually covered at cupola sessions. Records on sand will help to prove the answer when iron is responsible.

The author appreciates the fact that repetition of personal or an individual company's experiences is not always in the best taste. However, this Paper was requested by those in charge of the programme to show how a sand-testing programme was co-ordinated with moulding procedure in the chilled-iron car wheel industry, and especially how the Griffin Wheel Company worked it out in its foundries. Any success attained has depended upon the co-operation of the entire personnel.

Sand Studies

Because of its many phases, when a foundryman starts talking about sand, he can indulge in detail without becoming too technical. Primarily, any systematic check of sand is educational, and those who quibble about the subject do not understand how simple or interesting it is. The different plant organisations are enthusiastic, and their practical suggestions, combined with some theoretical knowledge, have produced better results. The programme is devoid of frills, and replies to inquiries are made in non-technical terms.

Wheel Moulding Losses

For years, losses in the moulding shops of the Griffin Wheel Company's foundries have been lower than the average for the industry and the different plant organisations pride themselves on their skill in holding losses to a minimum. Those making other kinds of castings explain the low loss percentage by suggesting that "losses should be low because they make only one type of casting." The latter part of this observation is undoubtedly justified, but when men who know their way about in jobbing or production foundries try making chilled-iron car wheels, they find that there are all kinds of specialists. There are many different types of foundries, but the chilled-iron wheel manufacturer is one who must work within narrower limits than most.

The Griffin Wheel Company has 12 plants spread over the United States, and as far back as any of the present organisation can remember, a monthly statement classifying losses by causes, with the total wheels made and percentages, has been sent to each plant. This report is looked for during the first week of each month, and has promoted a competitive spirit that prompts each plant organisation to put forth its best efforts at all times. There is also a co-operative spirit engendered throughout all plants to help the man who needs it most.

A.F.A. Recommended Sand Testing Equipment

The first A.F.A. sand testing equipment for any of the foundries was purchased for the Kansas City plant in January, 1930. Prior to that, the vibrating bottle sand tests, advocated by the late Eugene Smith, Crane Company, Chicago, had been used at the Detroit plant for about six years. In July, 1931, the first order was duplicated with more complete accessories for the company laboratory in Chicago. All plants were then advised to send in samples at their convenience, and a haphazard checking of sand was followed, until a centralised system was established in July, 1934. This included monthly comparison statements that were sent to all plants without comments.

The start was from scratch, and very conservative. Monthly, each plant forwarded by mail representative samples of both heap and facing sands. The laboratory reported on permeability, green compression strength and moisture, with quarterly readings on fineness. After a short time, the fineness readings on facing sands were discontinued. This extra work was eliminated because facing is made from heap sands, with coal-dust additions, and the relationship to heap as to sand grain fineness was apparent.

The comparison reports distributed to all plants for the month of December, 1934, disclosed a wide difference in permeability, moisture content and grain size, both in the mechanised and manual plants. All moulding shop supervisors at plants understood from the very beginning that they could send in as many samples as necessary to study sand, and when these instructions first went out, the laboratory was flooded. Every sample received was analysed more to encourage the sender than for the information obtained. It did not take long to find out that, except for moisture, the sand did not change quickly. This does not mean that sand cannot be ruined rapidly, but it will not happen overnight when following measured practices.

Uniform Practices

With little study, it was found advisable to measure new moulding sand, sharp sand, and the amount of rebonding agent required for each mould to maintain good strength with regular permeability, and the moulding room men acted accordingly. Instituting measured practices and explaining the reason so that the moulders, or men at sand-handling plants, understood what they were doing with new sand or rebonding agents, was a big advance on establishing uniform daily results. New sand is placed on top of poured moulds to guarantee a thorough merging with used sands, and, while experts insist such practices burn out the clay bond in the shake-out bin, the author has never been able to detect the loss, or develop a better method.

Facing sands are all mulled and the proportions of bentonite, coal dust and heap sands are especially accurate. No intensive bonding agents are extensively used in heap sand, and the less expensive clays that have been found more durable are favoured.

* Extracted from a Paper presented to the New York Convention of the American Foundrymen's Association. The Author is on the staff of the Griffin Wheel Company.

Sand-Testing Practice

Moulding and Core Sands

It was natural for us, with the A.F.A. standard testing equipment available, to check all of the moulding sands, core sands and clays from deposits in the vicinity of the twelve plants. The Griffin Wheel Company foundries are spread from coast to coast, and, because of transport charges, are compelled to use sands available in their respective localities. The plant offices have complete records, with pertinent information on file for checking costs or mixtures and their sands are blended accordingly.

Heap and Facing Sand Specifications

After accumulating data for about one year without pressing the moulding room organisations too forcibly, the monthly sand control statements were arranged to include the recommended minimum and maximum, with a target for permeability, compression strength and moisture. These specifications are modified from time to time, as knowledge on sands is broadened, and those shown on the monthly reports are not necessarily the ultimate. At the start, the limits were made sufficiently flexible to meet moulding requirements in both manual and mechanical foundries.

In August, 1935, when the recommended limits were initiated, they were as follow:—

	Heap sand.			Facing sand.		
	Permeability.	Compression strength, lb.	Moisture, per cent.	Permeability.	Compression strength, lb.	Moisture, per cent.
Minimum	50	5.0	7.0	50	6.0	7.0
Maximum	125	6.5	10.0	70	8.0	9.0
Desirable	100	5.75	8.5	60	7.0	8.0

There has been good progress, although all of the foundries do not check exactly with the specifications. The laboratory findings on samples submitted exactly six years after those reported in 1934 show that real success has been attained in keeping within the specified tolerances.

Mould Hardness Testers

Each plant was furnished with mould hardness testing gauges during the latter part of 1936. The readings are taken at four designated points on both the cope and drag sides of the moulds. They are averaged for each of the points checked on different weights of wheels and reported to the operating department quarterly. These readings are not necessarily made all the same day, and, when tabulated, they are distributed to all plants for comparison purposes. The plants are particularly interested in the ramming of wheel moulds, because of the influence mould hardness has on controlling plate thickness to meet the Association of American Railroads weight specifications. To-date, no rigid limits for mould hardness readings have been set, but the moulding shop foremen advise that this instrument is a barometer which frequently exposes faulty conditions before they become serious enough to cause bad work.

Moulding Shop Losses

The following shows the progress made on improving losses since the first full year that sand control statistics were furnished to all plants:

Year.	All plants total moulding loss percentage.
1935 ..	1.03
1936 ..	0.89
1937 ..	0.85
1938 ..	0.67
1939 ..	0.71
1940 ..	0.56

Standard Practice Book

The founder of the Griffin Wheel Company, Thomas A. Griffin, was a firm believer in following the best known practices. During the early years of the company's development, he established a book covering the best methods of performing all operations. This 304-page typewritten loose leaf guide covers detailed rules of the daily work on every operation in all departments. These rules are changed as better applications are promoted. Visitors, when shown this book, usually marvel at the details of practices covered in very simple, understandable language.

The object of this remarkable book, that is kept up to date at all times, was described by one of the employees in 1915, as follows:—

> "Standard Practice is primarily the guidance of the entire organisation towards the manufacture of the best possible product consistent with the minimum cost of production, which can only be accomplished by each and every employee performing a similar operation, doing it in a similar way—the right way—and thereby saving an unnecessary waste of time, labour and money."

With a background built on years of adhering to specific rules, those in charge of operations did not hesitate to tackle a sand programme. It is worth the time of any industrial executive when visiting the Griffin Wheel Company to investigate this Standard Practice book.

Conclusions

(1) When losses or cleaning costs are excessive, the answer is not always sand, but how it is used can have a decided influence on effecting economies.

(2) Skilled foundrymen get results with almost any kind of sand, but unquestionably moulding shops can do better work with controlled sands.

(3) Sand control means systematic recording of findings and continuous study of results over a long period of time, then using the information to advantage.

(4) Advanced methods of moulding, either manual or mechanical, are not complete until guess work is taken out of blending and regulating the sand.

(5) There are some men who can guess the condition of sand, but hardly as accurately as mechanical measuring devices which will establish facts.

(6) There is nothing gained by purchasing sand-testing equipment and allowing dust and dirt to accumulate on it. The appearance of this equipment sometimes tells an interesting story.

(7) Although sand control equipment is mechanical measuring, there are variations depending upon the individuals performing the work. These delicate instruments are generally more accurate in laboratories than in any clean foundry.

(8) The quality of metal is the most important of the many features essential for good results, but foundrymen cannot afford to neglect sand-control because they do not understand the subject.

(9) When efficient sand practice is established in the shops, changes are slow, and monthly check appears to serve the purpose, except as to moisture control.

(10) Bad work blamed on sands is frequently lack of proper supervision. Foundry sands,

(*Concluded in next column.*)

(*Concluded from previous column.*)

under the best working conditions, are only as good as the men who use them.

(11) There is still a large tonnage of good sand going into refuse dumps at most foundries. Much of this sand can be salvaged to effect economies. In many instances, better sands are scrapped than some of the new sands foundries are using.

Light Metals and Alloys

As the result of a critical review by A.S.T.M. committee B7 on light metals and alloys, cast and wrought, of the specifications for aluminium and magnesium alloys under its jurisdiction and in order to provide for certain new alloys, revisions are recommended in sixteen tentative standards in a report laid before the recent A.S.T.M. meeting at Chicago by the chairman, Sam Tour. An immediate addition to the specification for aluminium ingots for remelting is the inclusion of requirements covering a 99.20 per cent. grade aluminium. In view of the present increased demand for aluminium for use in iron and steel manufacture, a modification of the zinc content in the 99.4 per cent. grade is recommended. Of principal interest in the revision of the specifications for aluminium-base castings is the addition of a new sand casting alloy having good mechanical properties in the as-cast condition. A table of general information with typical yield strengths for the sand casting alloys is presented for inclusion in the cifications as information.

In order to bring the requirements of the various specifications for aluminium wrought shapes in line with present commercial practice, revisions in certain tolerances that have been found necessary are recommended together with a few minor changes in composition requirements. In the specifications covering both cast and wrought magnesium alloys, the committee is proposing additional high-purity grades which offer improved resistance to salt water corrosion, although the mechanical properties are no better than those of the present commercial purity alloys. An appendix to the report gives corrosion data on all the magnesium alloys now covered by A.S.T.M. specifications and also of the proposed new high-purity alloys.

Casting in Rubber Moulds

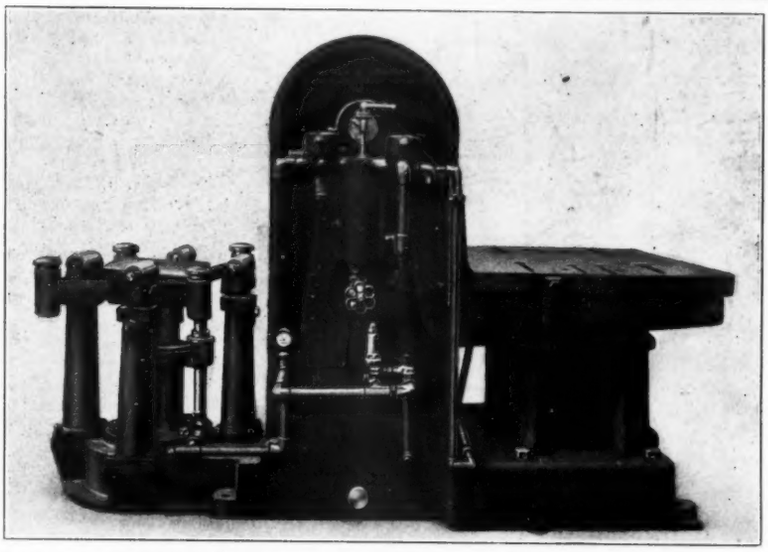
(*Concluded from page* 170.)

pieces in the mould. In present practice, this may vary from a minimum of six to as high as 150. It will be understood that a mould having deep undercuts or one cast at higher temperatures will not last as long. The casting speed is approximately 25 pours per hr. per machine, with one operator easily able to handle two machines.

The value of rubber moulds appears practically unlimited. Rubber moulds are not necessarily suitable for all castings. This method has found its greatest usefulness in decorative, ornamental and novelty work where absolute precision is not a determining factor. While fairly close tolerances may be obtained, casting in rubber moulds cannot, in all cases, closely duplicate the precision work of diecasting by the pressure method. Rubber moulds, however, have many advantages over any other method of casting as they reproduce perfectly any and all undercuts; they produce perfect detail without distortion, and can be made to cast the finest and most intricate designs.

Work is now under way for the adaptation of rubber moulds to the casting of higher melting point alloys, and the design of larger and more elaborate equipment is practically completed. The potential possibilities of rubber casting have just begun to be exploited. A big future appears to await this new and radical development.

MACNAB
Moulding Machines



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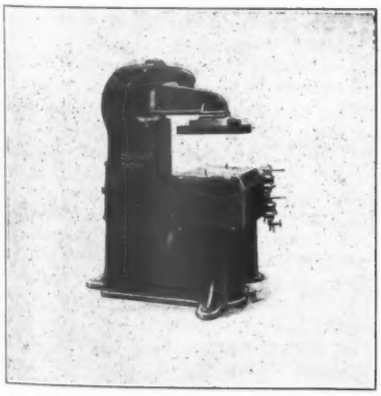

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Made in a range of sizes. Pattern Draw—Air on oil.

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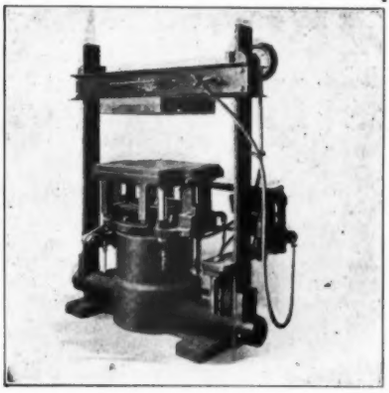

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Strip Rings

By JAS. TIMBELL

The production of cast-iron pulleys similar to the type illustrated in Fig. 1 necessitates well-fitting accurate moulding boxes and "tackle," if these are to be made by the usual method of pattern plates or "plastic sides." A shows a "crowned" pulley for the attachment to a flywheel by three lugs, B, which are machined level on this face, and internally on the lugs. These are centred by a spigot face on the flywheel boss, and no machining allowance is given on the belt face. The taper on the inside of the pulley leaves the whole inside strip in the bottom half of the mould.

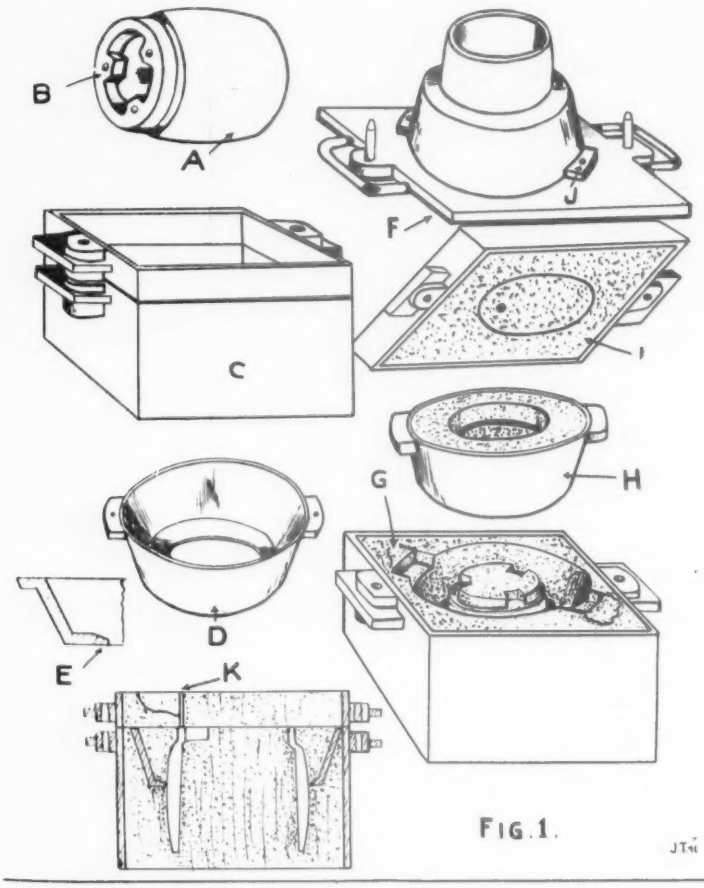

FIG. 1.

A continuous 12 a day supply was required, and the only available template moulding boxes were of the "loose pin" shallow top and deep bottom type shown at C. These, incidentally, are not the best kind to use where freedom from cross joint on this thin section casting is desirable.

These moulding boxes were brought into use and proved satisfactory in conjunction with the method adopted.

A set of strip rings were made as shown at D, the depth being exactly half of that of the metal pattern. The inside moulding space permitted of a generous taper, allowance for filing being left on the rough castings on the inside of the ring, where this part comes in contact with the pattern, as shown at E. The ring and pattern are worked "loose" and rammed up as is indicated at F, rolled over, and the inside ring space is rammed up in the usual way. A finger clearance is scooped out under the lifting lugs G, and the ring with the rammed-up half *en bloc* lifted out, as illustrated at H. This ring incidentally acts as a stripper, and a consistently clean lift is assured. The pattern is then drawn out of the bottom half of the mould and the ring replaced, odd lugs assuring the correct positioning.

A further improvement was made by adding dowels to ensure proper placing. They are shown at J. The tops, I, may then be made on another pattern plate with the ring runner attached, or by a runner peg as shown at K. When using the rings for the first time the edge which is in contact with the metal should be rubbed with blacking and oil; after repeated use, any "growth" can be filed away. Alternately, any loss or break away will call for a "run round" with the boss tool, and a blow out prior to ramming up this—after rolling over. Pulley castings made this way will be truly concentric and quite free from "overlap" or "twist"; rammed up in suitable sand they will be smooth enough for all ordinary purposes.

Freezing Points of Steel

Freezing point determinations on high-purity iron and on 23 other samples of iron and steels, each of which had been chemically analysed, have been made by the U.S. National Bureau of Standards, Washington. In this regard, "freezing point" means the temperature at which the melted metal starts to solidify. This temperature has one value for pure iron and quite different values when other elements are added to convert the iron into any one of the numerous varieties of steel and its alloys. The freezing temperature of high-purity iron (99.99 + per cent.) in an atmosphere of helium was measured with an optical pyrometer and found to be 2,802 deg. F. The same samples of iron were found to freeze 2 deg. lower in an atmosphere of hydrogen. In addition, the initial freezing temperatures of some irons of lesser purity and of some steels were measured in an atmosphere of helium to determine the effects of various impurities and alloying elements. Many combinations of 17 elements, which include all these generally found in commercial irons and steels, were measured.

Melting Furnaces for Grey Cast Iron

(*Concluded from page* 172.)

Difficulties of Electrical Furnace

MR. C. H. KAIN said it was wrong to suppose that the electric furnace would produce first-grade material from charges made up of steel borings and inferior scrap. Recarburisation to a constant figure was difficult of achievement. When discussing superheating of cast iron more explicitness was needed. Definite temperatures should be quoted since the extent of superheating for good results depended on the grade of iron and in any case it was definitely limited. The drawback was the difficulty in reading accurately temperatures over 1,200 deg. C. With the electric arc furnace it was difficult to maintain a controlled pouring temperature when the number of moulds to be cast was large, and the rotary furnace was more amenable to control in this respect. Regarding separation of charges in the cupola, the method advocated by Mr. Francis was satisfactory provided there was no great difference in the type of materials composing the charges. Where this was not so the method of blowing down, making up the bed and starting again, was the only reliable one.

Reviewer's Reply

MR. H. H. SHEPHERD, replying to the points raised, said that the Report did stress that blowing down was the ideal method of separation in the cupola. He agreed, too, that more diagrams would have added to the value of the Report. Commenting on the continuous supply of molten iron, he said he was referring to a single melting unit. He agreed also that a double row of tuyeres gave faster melting, with a tendency towards more fluid, cleaner and better iron. The deeper coke bed gave a better chance of superheating with less oxidation. A receiver was an advantage where it was required to collect one or more tons of molten metal, and for engineering castings of high quality, because of the tendency towards less carbon pick-up. On the other hand, a receiver usually gave metal of lower temperature; more patching also was required, and there was always a likelihood of trouble with the connecter block. Bull ladles could be used in place of a receiver, but here again the decrease in temperature was likely to be experienced. Although he had no data on the subject, he thought that the electric furnace was the best to operate from the health point of view. With the cupola there was the danger from down draft fumes at the charging hole. Fluorspar was a danger in this respect when used in large quantities as a flux. No cupola should be erected without a proper blower house, sucking clean air from outside the foundry. In reply to Mr. Brown, he said that there were very few efficient volume meters for cupolas, and, having had experience of their use, he preferred an accurate pressure gauge rather than an inaccurate volume meter. Weight of air and not volume was the real crux of the matter, and for this he advocated the positive type of blower rather than the fan, because, with the former, the blast was more uniform and steady and afforded better control. A positive blower, however, was more trouble to maintain mechanically, and had a higher initial cost. At this point MR. HALL said that he had two cupolas: one worked from a fan and the other from a positive blower. He confirmed Mr. Shepherd's preference for the latter.

Finally, MR. L. TIBBENHAM (Past-President) moved a hearty vote of thanks to Mr. Shepherd for his presentation of the Report. MR. KAIN seconded this, and it was acclaimed in the usual manner. MR. SHEPHERD made a suitable response.

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Psychological Factors in Accident Causation

AN ANALYSIS OF THEIR OCCURRENCE

That psychological factors are prominent in the causation of the majority of accidents, is the view expressed by MR. C. A. OAKLEY, B.Sc., in a Paper entitled "Psychological Factors in Accident Causation," read before the Birmingham Section of the Institution of Production Engineers.

A Psychological Conflict

The fact that we listen to details of accident frequencies without being alarmed for our own safety points to the existence within us of a defence mechanism. We regard these details of accident frequencies from the detached standpoint of a spectator. The accidents happened to other people, not to us. One of the fundamental elements in our psychological make-up is the disposition to shut out from ourselves facts which would disturb us very much. To some extent they are repressed, and we are aware of them subconsciously; but it would seem that we may completely overlook them, just as in an argument we may fail to comprehend a contrary point which is not closely associated with our own opinions. This protective attitude is, however, essential for the preservation of mental stability. It does not follow that, if we made an individual thoroughly frightened about his personal safety, he would be less liable to have accidents. Possibly—perhaps probably—he would be more liable to have them. Accordingly, this defence mechanism is not a thing to be tampered with lightly.

Why Men Have Accidents

We may say of a man who has caused an accident that:—(*a*) He was unaware that he was running a risk and was unable to or did not take the necessary precautions; (*b*) he was aware that he was running a risk and was unable to take the necessary precautions; or (*c*) he was aware that he was running a risk and did not take the necessary precautions. All of these are of interest to psychologists, and the author sketches the various aspects under the three headings, and then deals with them in more detail.

(*a*) It does not follow that because a man did not know he was running a risk he could not have taken precautions against being hurt. He may have already formed a safety habit, such as looking both ways before stepping from the pavement on to the roadway; and so, without any conscious realisation of what he was doing, have avoided being knocked down.

(*b*) It is improbable that men are still called upon to do a hazardous job without being provided with any kind of protection. Whether the protection is entirely satisfactory and whether they are really guarded against all eventualities is perhaps less certain. A man may realise that he is running risks, and yet because of a weakness within himself be incapable of taking adequate precautions. His manual dexterity may be low even though the air conditions in the room are hot rather than cold. Clumsy-handed people are, however, not often allocated to dangerous work. Less easily detected is sluggish sensory-motor co-ordination—some people react much more quickly than others to visual, auditory or other signals—that is to say, they are much more able than others to get safely out of awkward predicaments.

Not only, however, may a person in an unexpected happening be involved in an accident because his reactions are too slow. He may be incapacitated by a physical weakness, such as high blood pressure. He may have a nervous temperament, and become flurried. Or he may not know what is the right thing to do—that is to say, his accident is attributable to faulty training. On the other hand, his training may have been on the whole efficiently carried out, but he may have developed a defective method of working, perhaps undetected by others or by himself, which leads him to keep on doing one particular thing or group of things in a dangerous way. Particularly puzzling are the cases of men who make a mistake in work which they have done regularly and thoroughly for many years. Whatever may be the actual explanation, it will probably have something to do with distraction of attention.

(*c*) In all of these cases the worker, if he had been able to protect himself, would have done so. But sometimes it would seem that he just did not bother to protect himself. Why? The explanations are of two orders—stupidity and perversity. Stupidity may be attributed to low-grade intelligence or to some kind of recklessness. Perversity may be attributed to a comparatively simple behaviour tendency, such as contra-suggestibility, or to a more complex tendency, such as social unco-operativeness.

Accident Proneness

The next three topics—sensory-motor co-ordination, physical incapacity, and nervous temperament—may be discussed together under the heading of accident proneness. This aspect of the subject has received much attention during the last few years, largely because it has been proved that some persons are more prone to suffer accidents than others. It should be noted, however, that this in itself does not justify the assumption that each individual has a characteristic degree of accident liability. There are other possible explanations, such as that having one accident increases liability to have others, perhaps by making the sufferer too apprehensive or resentful, especially if there has been delay and haggling over his compensation. The author says, in passing, that so far too little attention has been given to after-accident effects, particularly in cases of sudden and frightful accidents. Or the explanation may be found in faulty selection or training, or in the frequent repetition of a mistake. The opinion held in psychological circles, however, is that even after there have been removed from a group of apparently accident-prone people those whose bad accident record can be explained in any other way, there will remain a core, perhaps quite small, of people who are really accident-prone in consequence of a personal characteristic.

Effect of Physical Incapacities

Certain physical incapacities, such as defective eyesight and hearing, undoubtedly tend to increase accident-proneness; but the author does not know that there is yet any evidence to justify the impression held in some quarters that high blood pressure and kidney disease may be associated with proneness to have accidents. He personally is much interested in the suggestion that people who have a tendency to "lose their heads" may be prone to have accidents. Tests of the capacity not to get flurried are used by certain stores when selecting sales assistants, but the author has never heard of these tests being used to measure accident-proneness. Outstanding among the other possible explanations of accident-proneness is undoubtedly faulty training.

The most perplexing industrial accidents are those experienced by the trustworthy worker who makes an incredible mistake in a routine job he has done satisfactorily for many years. The explanation in these cases has clearly to be found outside of the job itself. Sometimes the injured man is able and willing to say what has "upset" him—perhaps he is worried about a member of his family who is ill, or about becoming involved in debt. This points, incidentally, to the harm which can result from nagging, bullying, hectoring and other causes of irritation and anxiety.

Often, however, the sequence of events is less clearly defined and one of the greatest benefits derived by a firm from having its own safety organisation is that an inquiry into the causes of an accident can be held shortly after it has happened. The statement is often heard that, whatever excuse may be made for an accident happening once, there can be no excuse for another accident of the same kind happening. Frequently, however, it is almost impossible to ascertain why a particular accident did happen. The evidence of eye-witnesses is often, perhaps usually, unreliable.

Stupidity and Perversity

Accidents which seem to be attributable to lack of concern on the part of the persons who caused them are so stupid that one's first reaction is to wonder whether the levels of intelligence of the individuals concerned are not below average. No doubt inability to apprehend the risks being taken does sometimes lead to accidents. A fundamental element in much recklessness is the desire to "show off," possibly before others, but perhaps merely to gratify a personal longing for superiority. The craving for speed which causes many accidents may be explained in this way. There are, however, other factors, such as the slapdash way in which some persons approach everything they do.

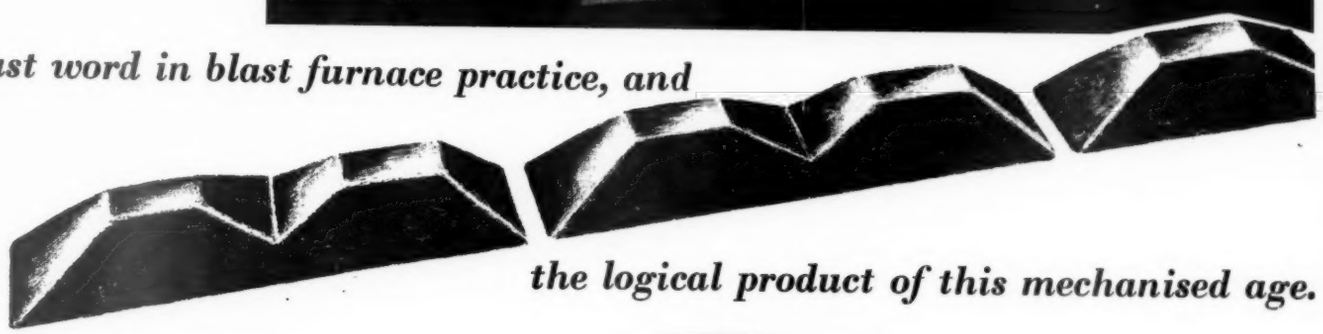
The fact that some accidents are attributable to perversity is distressing, but its existence has to be admitted. Highly contra-suggestible people frequently act in manners opposite to those suggested to them. This involves them at times in running serious risks. Such people often have a record of selfishness, insubordination, grumbling, rebelliousness and quarrelling. They are inclined to be dissatisfied with their jobs, complaining about their friends, and difficult in their home life. Sometimes they develop anti-social tendencies. The sense of social responsibility is not highly developed in everyone and, while few persons would consciously do anything to maim their fellows, there are some who are lax in the precautions they take to avoid hurting them. This may be observed in the casualness with which they behave after they have involved others in an accident. No doubt in many instances this is merely a pose to hide a keen feeling of guilt. But not always. That directs attention to what is undoubtedly the worst feature of the subject of accident prevention. It is that frequently the person who suffers the consequences of an accident is not the person who was responsible for its happening.

Raising Blast-Furnace Throughput

Discussing means for increasing the throughput of blast furnaces by reducing the time the burden remains in the stack, M. S. GONTSCHAREWSKI in "Teor. prakt. met." establishes the mathematical relationships between an increase in stack temperature and an increase in the velocity of reduction. Laboratory experiments indicate that reduction can be accelerated and throughput increased by heating the burden to between 550 and 650 deg. before charging to the stack.

STANTON

Last word in blast furnace practice, and



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The Week's News in Brief

Trade Talk

NEGOTIATIONS are said to be taking place with a view to resuming work on Eire's national steel industry at Haulbowline.

AN ORDER FOR 33 locomotives and tenders for the Ministry of Supply has been received by the North British Locomotive Company, Limited.

JOHN I. THORNYCROFT & COMPANY, LIMITED, engineers and shipbuilders, has given notice of satisfaction in full of a trust deed dated July 24, 1906, securing £150,000 of debentures.

VEREINIGTE ALUMINIUMWERKE report a gross profit of 82 million Rmk. in 1940 and a net profit of 2,000,000 Rmk, substantially the same as in 1939. An unchanged dividend of 7 per cent. has been declared.

THE BOARD OF TRADE have made an Order amending the War Damage (Business Scheme) Order, 1941, to permit insurance of goods used in the course of mining operations when the goods are below ground under the Business Scheme on a voluntary basis.

A MEETING was held at Manchester on Thursday last week to form a Sheet Metal Industries Association. About 500 invitations to manufacturers and technicians engaged in sheet-metal working were issued. Other meetings are to be held in London, Birmingham, Sheffield, and Scotland.

THE INTERNATIONAL NICKEL COMPANY OF CANADA is to spend $25,000,000 in the next three years on plant extension to increase output and to ensure the maximum supply of nickel for war and defence purposes. In both Canada and the United States drastic curtailment of the use of nickel for non-essential purposes is also under way.

AN ILLICIT TRADE in the sale of wolfram and tin has grown up in Portugal since the war. In the provinces bordering on Spain, large gangs of men and women wash and sort ore from the soil. As all metals belong to the State and cannot be prospected for without a licence, this "black trade" is illegal. The authorities are taking measures to stamp out the trade.

THE UNITED STATES VANADIUM COMPANY, a subsidiary of the Union Carbide Company, is about to place in operation a tungsten concentrating plant with a capacity of 1,000 tons per day at Pine Creek, near Bishop, California. It is said that there is enough ore blocked out to keep the mill operating for 20 years and a prospect that large supplementary deposits will be developed.

LORD KINDERSLEY, president of the National Savings Committee, in a speech made in London, said that group saving was the backbone of the savings movement. The majority of employers were very helpful, but there was a certain number of employers who still resented the work and trouble entailed by running a group, and failed to realise that it was for their own protection against the disaster of inflation that they were asked to contribute this modicum of effort.

THE HAMMOND LANE METAL COMPANY, LIMITED, Dublin, which is associated with the Hammond Lane Foundry, has purchased the Howth (County Dublin) Tramway, a suburban line embracing about seven and a half miles of track. The rails, sleepers and overhead equipment are included in the sale. The purchase price has not been disclosed. The Hammond Lane firm has recently dismantled the Lucan (County Dublin) Railway, the Westport to Achil Railway, the Kinsale Junction Branch Railway and the Keady branch line.

WITH THE ENTRY into factories of more persons on the labour and personnel management side, the Industrial Welfare Society's correspondence course in industrial law serves a useful purpose in providing them with knowledge of the legal principles affecting their work. The course does not presuppose previous legal training on the part of those taking it, and consists of six complete lectures. Further particulars may be obtained from the Secretary, Industrial Welfare Society, 14, Hobart Place, Westminster, London, S.W.1.

THE BOARD OF TRADE have made an Order prohibiting, as from last Thursday, except under licence, all exports of iron and steel door and window frames and casements and of the following kinds of aluminium goods: Containers, fishing reels and fishing rods, knitting needles and knitting pins, knives, forks and spoons for domestic use, rivets, including tubular rivets. The Order is called the Export of Goods (Control) (No. 31) Order, 1941, and is published as S.R. & O. 1941, No. 1310.

UNITED STATES STEEL-INGOT CAPACITY available for civilian use at the end of 1941 will be greater than the industry's production for all purposes in any past year, states the chairman of Republic Steel Corporation in a letter to stockholders. Capacity at the year-end will reach about 91,000,000 net tons, 9,400,000 tons more than at the close to 1939 and 30,000,000 tons above 1918. Government estimates place defence needs and aid-to-Britain at about 23,000,000 tons, leaving about 67,000,000 tons for ordinary civilian use. This is a record-breaking amount since the total output has never reached this high level, being 66,993,219 tons in 1940.

THE COMPOSITION OF THE MISSION representing both management and labour in British industry which is to visit the United States at the invitation of the Council of the Office of Production Management, for the purpose of making a tour of the defence industries, is as follows:—Management representatives: Mr. F. C. Braby (managing director, Frederick Braby & Company, Limited); Mr. C. K. F. Hague (director, Babcock & Wilcox, Limited); Mr. C. P. Lister (chairman and managing director, R. A. Lister & Company, Limited); and Mr. J. S. Turner (managing director, Moira Colliery Company, Limited). Labour representatives: Mr. A. A. H. Findlay (United Patternmakers' Association); Mr. G. A. Isaacs, M.P. (National Society of Operative Printers and Assistants); Mr. J. Kaylor (Amalgamated Engineering Union); and Mr. W. Lawther (President of the Mineworkers' Federation of Great Britain).

Personal

MR. ARNOLD TIPPER, M.Sc., has joined the staff of Langley Alloys, Limited, of Slough, as development and research engineer.

MR. H. W. HUNT, a director of the Chillington Tool Company, Limited, of Wolverhampton, has been appointed deputy area commander of the Stoke-on-Trent area under the new national fire service organisation. Mr. Hunt, who is a commandant in the A.F.S., has been in charge of the Wolverhampton A.F.S. since 1938.

Wills

FERGUSON, ROBERT, engineer and shipbuilder, of Greenock	£3,463
LISTER, LAURENCE, of Heckmondwike, Yorks, machine maker	£9,101
BESTON, STANLEY, of Stevenage, Herts, chairman of the Morgan Crucible Company, Limited ...	£340,044
SUMMERSON, R. B., chairman and managing director of Thomas Summerson & Sons, Limited, railway engineers and iron and steel founders	£14,903

Obituary

MR. JAMES HENRY COLE, managing director of Warwill, Limited, brass and iron founders, Abertillery, Mon., died at Newport on August 29.

MR. FRANCIS WALKER, lately executive manager, Imperial Chemical Industries, Limited, London died at Dulnain Bridge, Glasgow, on Saturday

Contracts Open

High Wycombe, September 22—Supply and installation of a centrifugal borehole pump and electric motor to pump 160,000 g.p.h., with control and switchgear, pipework and valves, etc., for Chepping Wycombe Town Council. The Borough Water Engineer, 70, Easton Street, High Wycombe, Bucks. (Fee £2 2s., returnable.)

Howden—Supply and erection of a borehole pump, with alternative motor and Diesel engine drives, for the Rural District Council. Mr. John H. Haiste, consulting engineer, 22, Queen Square, Woodhouse Lane, Leeds, 2.

Joint Council of Iron-Founding Employers' Association

A meeting was held at Grosvenor House, Park Lane, London, last Tuesday, under the chairmanship of Mr. FitzHerbert Wright, of representatives of practically all the employers' associations within the foundry industry. It adopted, with minor modifications, the articles of association and constitution which had previously been circularised to the federations. This was unquestionably the most representative meeting of the iron-founding employers which has ever been held. Any foundry concern anxious to do its best for the welfare of the nation and the industry should ascertain whether its interests are represented on the Joint Council and, if not, should take steps to join one of the dozen or more associations participating.

De Lavaud Appeal

The unsuccessful action brought against the Clay Cross Company, Limited, of Clay Cross, Derbyshire, in connection with a patent relating to improvements in the production of unhardened metallic castings in metal moulds, will have a sequel in the High Court of Appeal, an appeal having been lodged by the International De Lavaud Manufacturing Corporation, Limited, of Toronto, Canada, who are challenging the judgment of Mr. Justice Bennett, who dismissed the action in the Chancery Division last May after a lengthy hearing. The International De Lavaud Manufacturing Corporation claimed to be the owners of the patent. Damages only were claimed against the Clay Cross Company in the action, it being stated that the patent expired shortly before the trial of the case began. The appeal by the International De Lavaud Corporation will be heard by three Lords Justices of Appeal.

Reports and Dividends

A. C. Wickman—Interim dividend of 5 per cent. (same).

Trianco—Net profit for 1940, £24,507 (£15,822); dividend on the ordinary shares of 10% (8%).

British Oxygen—Interim dividend on the ordinary stock of 7%, less tax, on account of 1941 (same).

Cammell Laird—Interim dividend on the ordinary stock of 4% actual, less tax, on account of the year ending December 31 next (same).

Warne, Wright & Rowland—Net profit for the year ended December 31, £14,814 (£8,554); dividend on the ordinary shares of 7½% (15%).

Electric Furnace—Net profit for year ended March 31, £47,662 (£48,802); to taxation, £31,000 (£24,000); dividend of 7% (8%); forward, subject to directors' remuneration, £6,961 (£6,650).

Briggs Motor Bodies—Net profits, after taxation, for 1940, £105,249 (£87,431); provision for premiums under War Damage Act, 1941, £20,827; to general reserve, £40,000 (unchanged); forward, £47,348 (£43,176).

Humphreys—Net profit for the year ended November 30, £42,370 (£49,828); to taxation reserve, £15,000 (£20,000); dividend on the ordinary shares of 10% (same); no bonus (2½%); forward, £55,710 (£43,841).

Incandescent Heat—Net profit for the year ended December 31, after writing off depreciation and making provision for income tax and N.D.C., £7,008; brought in, £2,931; written off patents, £3,375; forward, £6,564.

Larmuth & Bulmer—Profit to March 31 last, after depreciation and taxation, £3,024 (£6,311); dividend on the preference shares, £1,302; final dividend of 7½% on the ordinary shares, making 10% (12½%); forward, £5,106 (£6,497).

Thorn Electrical Industries—Net profit, after taxation, for the year ended March 31, £25,634 (£24,263); dividend on the ordinary shares of 20% (same); to general reserve, £15,000 (same); forward, £6,733 (against £7,823 brought in).

Darlington Railway Plant & Foundry—Profit for the year ended April 30, £10,433; depreciation, £1,888; reserve for contingencies, £1,000; reserve for taxation, £4,000; payment of interim dividends, £1,394; brought in, £2,730; final dividend of 2½% on the 5% non-cum. preference shares, less tax, £162; final dividend of 5% on the ordinary shares, less tax, £1,050; carried forward, £3,668.

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Raw Material Markets

All qualities of iron and steel required in connection with the production of war materials are readily forthcoming, and delivery has been speeded up, but it is still the policy of the Control to exclude all ordinary domestic uses. In certain instances it is possible for consumers to purchase material in excess of their immediate needs, and useful stocks are being accumulated. On the whole, however, licences are being granted only on account of early requirements.

Pig-Iron

MIDDLESBROUGH—The supply of high-phosphorus iron continues to be quite sufficient to satisfy all demands, and users have been able to lay down stocks. This type of iron is used in the main by the light-castings trade, but since the shortage of low-phosphorus and hematite irons became accentuated quite appreciable tonnages have been incorporated in furnace mixtures. While such a rearrangement of recognised furnace practice is not wholly satisfactory, in many cases the use of high-phosphorus iron has proved an excellent substitute, as, also, have refined irons and scrap. Only moderate activity is reported among the light-castings industry in this area, and deliveries of iron from the Midlands have been in excess of consumption. Ironmakers on the North-East Coast are operating to capacity on the manufacture of metal for the steel plants.

Strict control is still being exercised over the distribution of East Coast hematite, demand for which is maintained at a high rate. The Control authorities, generally speaking, will not grant licences for the purchase of hematite if it is possible for buyers to utilise refined irons, with the result that the call for supplies of the latter is on a record scale. In addition, ferro-manganese and malleable iron are well taken up. Every effort is made to expand hematite production, and much larger tonnages would be absorbed if they were available.

LANCASHIRE—Textile-machinery making continues to be a dull spot so far as consumption of pig-iron is concerned, but there has been some slight improvement in the position obtaining at several works making light castings and also among jobbing foundries, although neither of these branches is fully employed. On the other hand, heavy foundries are briskly engaged on Government contracts and other work of high priority and pressure for foundry iron is keen, especially from electrical engineers and machine-tool manufacturers. Extensive use continues to be made of special refined irons.

MIDLANDS—Part-time working is being experienced at many of the firms employed on light-castings production in this district, and it cannot be expected that there will be any early improvement, as there is little important use for light castings at the present time. The export trade, upon which the industry relied to a large extent in peacetime, is virtually dormant, so that short time may be expected at these works until the return of happier days. High-phosphorus iron is the chief material used by makers, and ample supplies are available to satisfy all needs. This type of iron is also being used more extensively in the mixtures of the heavy engineers in order to eke out the supply of better quality irons, such as hematite and low-phosphorus iron. There is plenty of business for these concerns, a large part of it being for Government departments. Neither low-phosphorus iron nor hematite is coming forward in sufficient quantities to meet requirements, but the methods of distribution ensure that all urgent needs are met.

SCOTLAND—While there is no surplus, adequate deliveries of pig-iron are reaching the foundries, and consumption is on a large scale, particularly among the heavy engineering industries. Unfortunately, it has not been possible for users to build up stocks, and deliveries for current use only are permitted, but in respect of high-phosphorus iron reserves are on hand at many consuming points. This type of iron, which is largely taken up by makers of light castings, is plentiful, and consumption is below normal, as the foundries in the Falkirk area have room for much additional business, which, unhappily, is not forthcoming. The steel industry continues to be a big consumer of iron, and larger tonnages of hematite, particularly, would be appreciated.

Coke

No delay is experienced in deliveries of foundry coke, and users are likely to have considerable stocks on hand before the advancement of winter. Producers have for some time past been willing to enter into forward contracts on the basis that the price paid be the current quotation at the time of delivery. For delivery to Birmingham and Black Country stations, the present price for Durham best fuel is 62s. 9d. per ton.

Steel

Business in steel for constructional purposes remains somewhat subdued, while there has also been a decline in the demand for black and galvanised sheets. In other directions, however, the pressure on the steel industry is unrelaxed, and, in fact, even larger tonnages of certain descriptions are being called for, especially those grades vital to the production of munitions, etc. These are mainly alloy steels, output of which is being enlarged wherever possible. The steel requirements of the shipbuilding industry are insatiable, while the needs of other heavy trades, such as the wagon, boiler and tank industries, are also very considerable.

Scrap

Some sections of the scrap iron and steel market are quiet, as the amount of metal available is in excess of the demand, but certain other grades remain rather tight. Consumers are keen to place scrap into stock, as they have been warned several times that supplies of American material are likely to cease. The chief difficulties at the present time are in the heavier qualities, and works are pressing for increased deliveries. Cast-iron scrap for the foundries is active, but arrivals, generally, are satisfactory.

Metals

COPPER—Manufacturers using copper appear to be as busily employed as ever; nor is there likely to be any decline in operations for the duration of the war, as working-up industries are participating fully in many priority contracts for various Government departments. Adequate supplies of copper are being delivered to these concerns, but the amount of the red metal available for other than work of national importance remains negligible. In the United States, every effort continues to be made to expand copper production, and the Government has offered a subsidy of 1 cent per lb. to three high-cost producers, which sum is to be paid in excess of out-of-pocket costs. The producers concerned in the offer have not been publicly named, so that it is not possible as yet to estimate the additional output which may be expected to result from the scheme. It would appear that chief difficulty in respect of copper supplies in America is experienced by the smaller consumers, who are pressing for the early delivery of September quantities.

TIN—It is probable that the next meeting of the International Tin Committee, which is to be held on Tuesday, September 16, will be adjourned without any conclusion being reached regarding the extension of the restriction agreement from January 1 next. Representatives of all signatory countries, with the exception of French Indo-China, are expected to attend the meeting. The replies of Malaya and Nigeria to the Committee's recommendations will, it is understood, be made known at the meeting, thus leaving the Bolivian reply outstanding; a Bolivian representative is expected to arrive in London shortly. The suggestion that the meeting may be adjourned is made in view of the lack of plenary powers accredited to the present delegates, and it is thought that Government representatives possessed of full powers will later meet to decide the trend of events after the termination of the existing scheme. On the other hand, of course, negotiations for a renewal of the scheme on the lines of the recommendations of the I.T.C. may progress far more rapidly than is thought probable in certain quarters.

A. Strauss & Company, Limited, 37-39, Lime Street, London, E.C.3, in their monthly tin review, suggest that the main cause for small consumer demand on the London market is presumably the falling off in tinplate production for export. This trend, combined with the fact that no tin may be shipped away from this country, should result over a period of some months in a steady rise in the United Kingdom stocks. One may fairly presume that when that process has continued until the stocks in this country have attained a still safer level, export licences will again be granted. This may well happen before the end of the year.

Tin prices on the London Metal Exchange during the past week have been as follow:—

Cash—Thursday, £256 to £256 5s.; Friday, £256 to £256 5s.; Monday, £257 to £257 5s.; Tuesday, £257 15s. to £258; Wednesday, £257 to £257 5s.

Three Months—Thursday, £259 5s. to £259 15s.; Friday, £259 to £259 10s.; Monday, £259 15s. to £260; Tuesday, £260 5s. to £260 10s.; Wednesday, £259 15s. to £260.

SPELTER—Brassmakers and die-casters continue to absorb substantial quantities of spelter, especially on account of Government orders. A moderate flow of zinc is also reported to the galvanising industry, although this trade is not particularly well employed at the present time. Ordinary domestic consumption of spelter has been drastically curtailed.

LEAD—The use of lead continues to be restricted, as the volume required for war purposes is not heavy, while ordinary outlets are greatly reduced. Ample supplies are found for all important orders, but the Control will not permit metal to be used freely except for worthwhile projects.

Applications for Trade Marks

The following list of applications to register trade marks has been taken from the "Trade Marks Journal":—

"BICORD"—Soldering fluxes and metals. British Insulated Cables, Limited, Prescot, Lancs.

"PARAMOUNT STEEL"—Steel. HENRY JAMES HENBREY, 6, Willersley Close, Sidcup, Kent.

"VERALOY"—Machine tools. HARD ALLOYS, LIMITED, 54, Victoria Street, London, S.W.1.

"WINTOOLS"—Machine tools. ROGER POLLAK, "The Cloisters," Hurley, Maidenhead, Berks.

"TYESULES"—Metal capsules. JOHN TYE & SON, LIMITED, 457, Caledonian Road, London, N.7.

"PHANOTARE"—Slow combustion stoves. JOSHUA BIGWOOD & SON, LIMITED, Wednesfield Road, Wolverhampton.

"SPEAR" and "JAVELIN"—Nuts, bolts, rivets, washers, etc. SIMMONDS AEROCESSORIES, LIMITED, Great West Road, Brentford, Middx.

"PRECALORIE"—Steam boilers and plate metal shells. DANIEL ADAMSON & COMPANY, LIMITED, Engineering Works, Dukinfield, Ches.

"CENTEC"—Machine tools. CENTRAL TOOL & EQUIPMENT COMPANY, LIMITED, Central House, Upper Woburn Place, London, W.C.1.

"ACTARC"—Arc welding machines and machine tools. INTERNATIONAL WELDING COMPANY, LIMITED, 2, South Parade, Bedford Park, London, W.4.

"GACO"—Conveyor and driving belts for machinery. GEORGE ANGUS & COMPANY, LIMITED, 152-158, Westgate Road, Newcastle-upon-Tyne, 1.

"THE MANOR"—Cooking stoves and heating apparatus. MANOR ELECTRIC OVEN & FIRE COMPANY, 175, Windsor House, Victoria Street, London, S.W.1.

"FLEXILANT"—Buffers for vehicles, draw bars for railway couplings, shock absorbers, etc. RUBBER BONDERS, LIMITED, Watling Street, Dunstable.

"MELLOZING"—Hand tools for spraying molten metal and metal ingots. MELLOWES & COMPANY, LIMITED, Eclipse Works, Corporation Street, Sheffield.